



CLIENT: Khalda Petroleum Company

PROJECT/JOB TITLE: Qasr Compression Project FEED

DOCUMENT TYPE: REPORT

DOCUMENT TITLE: HAZID Study Report

GENESIS JOB NUMBER: J08509A

DOCUMENT NO./ J08509A-F-HA-20036
FILE NAME:

D1	01-11-11	Issued for Project Use	RSB	RAJ	RP	
B1	06-10-11	Issued for IDC / FCC	RSB	RAJ	RP	
Rev	Date	Description	Issued By	Checked By	Approved By	Client Approval

Table of Contents

GLOSSARY	5
EXECUTIVE SUMMARY	7
1 INTRODUCTION.....	8
1.1 PROJECT DESCRIPTION	8
1.2 DEFINITIONS	9
1.3 TERMINOLOGY	9
1.4 PURPOSE.....	9
1.5 SCOPE.....	10
1.6 TIMING, LOCATION AND ATTENDANCE	10
1.7 METHODOLOGY	11
2 DOCUMENTATION	12
3 CONCLUSIONS.....	13
3.1 ACTIONS ARISING FROM THE HAZID	13
3.2 ACTIONS FROM THE CONCEPTUAL HAZID.....	15
4 REFERENCES.....	18
APPENDIX A – HAZID GUIDEWARDS	19
APPENDIX B – LIST OF ASSUMPTIONS AND ASSURANCES.....	22
APPENDIX C – HAZID WORKSHEETS.....	23
APPENDIX D - HAZID DOCUMENTATION	42

Table of Figures

Figure 1-1 Qasr Development Location.....	8
---	---

Table of Tables

Table 1-1 HAZID Attendees	10
Table 2-1 Layout Drawings	12
Table 2-2 PFDs	12
Table 2-3 Other Documentation	12
Table 3-1 Summary of HAZID Actions	13
Table 3-2 Summary of Conceptual HAZID Action Status.....	15

HOLDS LIST

HOLD	Description	Section

REVISION HISTORY

(Only after Revision D1)

Rev.	Description	Section

GLOSSARY

GOGC	Genesis Oil and Gas Consultants Ltd
Khalda	Khalda Petroleum Company
BDV	Blowdown Valve
BTEX	Benzene, Toluene, Ethyl Benzene and Xylenes
EER	Escape, Evacuation and Rescue
EGPC	Egyptian General Petroleum Company
EPC	Engineering, Procurement and Construction
ESD	Emergency Shut Down
FEED	Front End Engineering Design
GOGC	Genesis Oil and Gas Consultants Ltd
HAZID	Hazard Identification
HC	Hydrocarbon
HVAC	Heating, Ventilation and Air Conditioning
ITT	Invitation To Tender
KPC	Khalda Petroleum Company
LER	Local Equipment Room
MAH	Major Accident Hazard
P&ID	Piping and Instrumentation Diagram
PFP	Passive Fire Protection
PPE	Personnel Protection Equipment
PSV	Pressure Safety Valve
SAMS	Safety Action Management System
SOL	Start of Line

HAZID Study Report
Qasr Compression Project FEED



SIL	Safety Integrity Level
UPS	Uninterruptible Power Supply
VESDA	Very Early Smoke Detection Apparatus

EXECUTIVE SUMMARY

General

GOGC has carried out FEED studies for the new Qasr Compression facilities, including a FEED HAZID study to identify hazards with a potential to impact personnel or damage assets.

The aim of this Report is to document the FEED stage HAZID study. The HAZID scope covers the new Qasr Compression facilities up to the tie-ins to the existing Qasr facilities.

The study identified 32 recommendations for action. All issues requiring close-out will be addressed via the GOGC SAMS Register.

Main Findings

The 32 recommendations for action raised in the HAZID cover a diverse range of topics relating to the design and operation of the new Qasr facilities. Those aspects of particular note are:

1. A significant number of actions require GOGC to incorporate specific requirements into the ITT, for implementation by the EPC contractor;
2. A number of lessons learnt on the existing facility have been incorporated into current HAZID actions;
3. The buffer vessel for storage of inert gas represents a significant hazard, and the need for such a large inventory is questioned;
4. The closed drains drum is located in a below-grade pit, and this poses a potential problem for accumulation of heavier than air flammable vapour.

In addition, the 26 actions identified in the Conceptual HAZID were reviewed. The majority of these had either been implemented already, or were incorporated into the current HAZID. A small residual number have been carried forward for action (see table 3.2). These actions will be recorded and managed in the GOGC SAMS Register.

1 INTRODUCTION

1.1 Project Description

Qasr is a large, normally pressured gas-condensate reservoir located in the Western Desert of Egypt approximately 525 km west of Cairo. The field is operated by Khalda Petroleum Company (KPC), a joint venture between Apache Corporation and Egyptian General Petroleum Company (EGPC).

Figure 1-1 Qasr Development Location



Field production is initially handled at the Start of Line (SOL) Qasr Plant. After initial treatment (cooling and water removal) the gas/condensate is exported to a combination of the Salam, Tarek and Obaiyed gas plants for further treatment.

The Qasr gas and condensate currently free flows from the wellheads through the Qasr Phase I and Phase II facilities and export pipelines to the SHAMS manifold and Salam gas plant under reservoir pressure. As the reservoir pressure declines the peak gas rate of 800 mmscfd will no longer be achievable. The Qasr Compression Project is designed to improve recovery as the reservoir production rate and pressure decline.

The Qasr Compression Project scope comprises:

- Gas turbine driven single stage compressor sets
- Condensate export pumps
- Power generation
- Utility systems

A Hazard Identification (HAZID) study was performed in July 2010 at the Conceptual Design phase of the Qasr Compression Project. This earlier HAZID was reported in document J7729A-F-RP-20004, Ref. 6.

The Pre-FEED study considered a number of alternative layouts, and the current layout is agreed to be the best option.

1.2 Definitions

For the purpose of this report, the following definitions apply:

CONTRACTING AUTHORITY OR “CA”	Khalda Petroleum Company
ENGINEER	Genesis Oil and Gas Consultants (GOGC)
CONTRACTOR	EPC Contractor or The Contractor(s) appointed by the CA for the supply of the equipment. Requirements of this specification shall be enforced at all levels of the CONTRACTOR’S procurement process. CA shall have access to all CONTRACTOR’S suppliers to the same extent as required of CONTRACTOR.
PURCHASER	CA, ENGINEER or CONTRACTOR
SUPPLIER/VENDOR	The party(s) which manufactures and/or supplies materials, equipment, technical documents/drawings and services to perform the duties specified by PURCHASER.
PROJECT	Qasr Compression Project
INDEPENDENT VERIFICATION BODY	Inspection Body or Authority appointed by the CA

1.3 Terminology

The word “shall” is to be understood as a mandatory requirement

The word “should” is to be understood as strongly recommended.

The word “may” is to be understood as an action to be undertaken at the SUPPLIER’s discretion.

1.4 Purpose

This document reports the results of the FEED Hazard Identification (HAZID) workshop for the Qasr Compression Project.

This HAZID study has been carried out in line with the principles laid out in Ref. 1. The HAZID intent was to ensure that all hazards and their impacts were identified,

and that appropriate measures are put in place to prevent, mitigate or control these hazards and that these are incorporated into the design.

The aim of the HAZID study was to:

- Identify hazards with a potential to impact personnel, or damage assets;
- Identify major accident hazards (MAH); and
- Recommend actions which further investigate, safeguard against, reduce or eliminate hazards.

1.5 Scope

The scope of this HAZID review covers all the new facilities provided as part of the Qasr Compression Project FEED and only applies to the GOGC scope of work. It has been conducted in accordance with GOGC HAZID Procedure; CON-PR-420. The detailed scope of work is set out in Ref. 1.

1.6 Timing, Location and Attendance

The HAZID study took place on 21st September 2011 in GOGC's offices, 262 High Holborn, London.

The attendees at the HAZID are listed in Table 1-1.

Table 1-1 HAZID Attendees

	Name	Position
1	Rod Bayliss	HAZID Chairman
2	Leigh Smith	Scribe
KPC		
3	Ayman Saleh	Project Manager
4	Samir Saad	HSE
5	Moataz El Salakawy	Projects General Manager
6	Mostafa Nabawi	Gas Operations General Manager
7	Mark Konecki	Deputy Gas Operations General Manager
8	Ibrahim Hammad	Process
9	Farrag AbdelKader	Process
10	Mohamed Ismail	Control & Instrument
11	Fahim Lotfy	Electrical / Ops
12	Ahmed Abdelmaksoud	Mechanical
PMC		

	Name	Position
13	Richard Catling	Project Management
14	Somu Janarthanan	Process
15	Hadi Moallemi	Control & Instrument
GOGC		
16	Richard Powell	Project Management
17	Russ Jenkins	HSE
18	Martin Cooper	Piping & Layout

1.7 Methodology

The review followed the methodology presented in the Genesis procedure, CON-PR-420 – HAZID (Ref. 1).

Before the HAZID review was started, GOGC clarified the design intention with particular reference to:

- Basis of design;
- Layout principles and constraints;
- Key philosophies.

The layout drawings and process PFDs were the main documents used as the basis for this HAZID.

The Hazard Identification process, which was prompted by the guidewords listed in Appendix A, followed a number of sequential steps:

- The operations associated with each hazard, and their potential causes for the accidents and their consequences, were discussed;
- Potential escalation mechanisms and mitigating effects of passive and reactive systems were identified;
- Ways in which the personnel could become injured or fatalities, and contingency measures that can be utilised to reduce the risk of fatality Identify, were identified;
- Recommendations to reduce risks were made, where agreed to be necessary; and
- The discussions were recorded on worksheets together with comments and recommendations.

The discussions were recorded in full to provide an audit trail. Any assumptions that were made, or assurances that were required were also recorded, and these are summarised in Appendix B.

2 DOCUMENTATION

This section lists the documentation that was reviewed in the HAZID study.

Table 2-1 Layout Drawings

Drawing Number	Title
J08509A-L-DW-14000	Start of Line Overall Plot Plan
J08509A-L-DW-14101	Compressor Area Plot Plan
J08509A-L-DW-14102	Generator Area Plot Plan
J08509A-L-DW-14103	Condensate Area Plot Plan

Table 2-2 PFDs

Document Number	Title
J08509A-P-DW-12101	Existing Coolers / Separators
J08509A-P-DW-12102	Compressors and Export System
J08509A-P-DW-12103	Condensate Handling

Table 2-3 Other Documentation

Document Number	Title
J08509A-P-SD-12001	Process & Utilities Basis of Design
J08509A-P-PH-12005	Flare, Blowdown and Vent Philosophy
J08509A-P-PH-12006	Control, Shutdown and Process Safeguarding Philosophy
J7729A-F-PH-20000	Design HSE Philosophy
J08509A-F-PL-20005	HSE Plan

3 CONCLUSIONS

3.1 Actions Arising from the HAZID

The worksheets prepared during the HAZID were projected onto a screen so that all team members could continuously follow, and comment on, the record. All actions are therefore complete and agreed by the study team, and should be readily understood by others.

The recommendations will be tracked and managed by the project's Safety Actions Management System (SAMS).

A total of 32 actions were raised during the HAZID. These are summarised in Table 3-1. Those prefaced with the word "consider" require further information or assessment to determine whether or not a more specific action should be implemented.

Table 3-1 Summary of HAZID Actions

REF	ACTION	BY
1	Ensure that piping design reflects lessons learnt from overhang weights on existing plant.	GOGC
2	Ensure that the EPC scope of work specifies requirement for quality control inspections during fabrication with reference to corrosion problems experienced on existing facilities.	GOGC
3	Ensure that EPC contractor quality control inspectors are aware of corrosion problems experienced on existing facilities.	KPC
4	Ensure that the EPC scope of work highlights the requirement for insulating joints where required.	GOGC
5	Ensure that EPC contractor confirms that insulating joints are fitted where required.	KPC
6	Ensure that the EPC scope of work specifies requirement for quality control inspections during fabrication with reference to valve body leaks experienced on existing facilities.	GOGC
7	Ensure that EPC contractor quality control inspectors are aware of valve body leaks experienced on existing facilities.	KPC
8	Ensure the scope of work for the EPC contractor requires design of the supports for all piping including 4" and below and that the supports are shown on the isometrics.	GOGC
9	Provide a schedule of tie-ins and incorporate into the EPC contractor scope of work.	GOGC
10	Ensure that the EPC contractor prepares a detailed design and execution plan for each tie-in.	KPC

HAZID Study Report
Qasr Compression Project FEED



REF	ACTION	BY
11	Specify a minimum size of 2" for small bore connections to process and utility lines.	GOGC
12	Consider the need for passive fire protection on the condensate suction drum support structure.	GOGC
13	Consider the need for active fire protection in the condensate storage area (current ongoing study).	GOGC
14	Check the dispersion of oxygen from the inert gas generator vent to ensure there is no adverse interaction with any hydrocarbon emission.	GOGC
15	Consider the need for flammable gas detection at the air intake into the instrument air building.	GOGC
16	Provide details of the instrument air building at SALAM, and its ventilation system.	KPC
17	Consider the necessity for 8 hours supply of nitrogen to the compressors.	GOGC
18	Specify a crash barrier to protect the inert gas receiver.	GOGC
19	Consider redesigning the closed drain drum so that all connections are top entry from above grade and the pit can be filled with inert material such as sand.	GOGC
20	Ensure that the specification for the gas turbine and compressor packages includes a requirement for thrown blade protection.	GOGC
21	Confirm that there are adequate arrangements to allow safe movement of compressor and turbine components within the compressor house, and onto a low loader on the access road.	GOGC
22	Ensure there is adequate separation between the new power unit and the existing power generators to allow good access to both.	GOGC
23	Provide a mobile self elevating work platform suitable for the change out of fans and motors on air coolers.	KPC
24	Consider the need for, and extent of, lightning protection.	GOGC
25	Ensure that the mercury bed specification includes a requirement for access to facilitate charging and discharging adsorbent e.g. flanged heads on the vessels.	GOGC
26	Ensure there are working platforms with adequate access around the condensate suction drums	GOGC
27	Ensure there are working platforms with adequate access to allow safe access to PSVs and BDVs	GOGC
28	Define the safeguards to prevent unauthorised access to switch rooms, and other live electrical equipment.	KPC

REF	ACTION	BY
29	Ensure the specification for HVAC equipment requires dampers to close on loss of power.	GOGC
30	Develop a procedure for good communication between operations and construction, both during normal operation and in an emergency.	KPC
31	EPC ITT package to include requirement for construction contractor's personnel to be inducted at site on KPC's safety requirements, which are mandatory.	GOGC
32	EPC ITT package to include requirement for contractor to develop and implement design for temporary access road including pipeline crossing.	GOGC

3.2 Actions from the Conceptual HAZID

A total of 26 actions were raised in the Conceptual HAZID. These were reviewed by the HAZID team, and their status is summarised in Table 3-2.

Table 3-2 Summary of Conceptual HAZID Action Status

ACTION	STATUS
Install gas detection at the condensate pumps. Gas detection type should be similar to existing equipment on site.	Agreed
Consider installation of gas detection in vicinity of the API separator	GOGC raised caveat about nuisance alarms. GOGC to assess dispersion distances from API separator
Install gas detection at the air coolers. Gas detection type should be similar to existing equipment on site.	
Consider line of sight gas detection between piperack and compression.	
Relocate air compressor and nitrogen package to near the new LER	Done - relocated
Check that there will be a nitrogen-oxygen analyser on the nitrogen package output with appropriate executive action.	Agreed
Provide bollards to protect the condensate pumps and fuel gas package from potential vehicle impact.	Agreed where necessary
Consider relocation of compression KO drums to improve maintenance access.	Done - relocated

HAZID Study Report
Qasr Compression Project FEED



ACTION	STATUS
Carry out stress analysis of existing piperacks with new piping	See action 001 of current HAZID
Review compressor seal design and possibility of not using nitrogen.	Not recommended by GOGC
Ensure that equipment materials take account of the CO ₂ concentration in the hydrocarbon gas	Done – duplex specified
Ensure that equipment materials take account of the mercury concentration in the hydrocarbon gas	Done – MRU provided at fuel gas only to prevent exposure of aluminium components in GTs
Review potential for sand production under the new reservoir operating conditions	Action on KPC – none foreseen
Review potential for free water production under the new reservoir operating conditions	Action on KPC – none foreseen
Review frequency of fire and gas detector maintenance and consider whether faults or false alarms justify increased maintenance.	Action on KPC
Provide appropriate lightning protection on local vents handling flammable gases and vapours.	See action 024 of current HAZID
Ensure that all electrical equipment is specified with suitable labels and means of isolation consistent with KPS policies	Agreed
Ensure adequate access for maintenance to turbine enclosures, air filters and roof mounted equipment.	Done – compressor house layout updated
Ensure turbine access platforms are load bearing and designed not to obstruct engine change.	Done – compressor house layout updated
Ensure adequate access to air cooler motors.	See action 023 of current HAZID
Provide an automated start-up sequence for compressor units	
Consider provision of a power management system that incorporates both the existing and the new generators	Not required.
Ensure that equipment is provided to enable site emergency alarms to be heard within the construction site	See actions 030 and 031 of current HAZID

HAZID Study Report
Qasr Compression Project FEED



ACTION	STATUS
Designate a suitable access route into and out of the construction site which is capable of carrying all loads and with no impact on existing facilities.	See action 032 of current HAZID
Ensure that all temporary equipment is suitable for the hazardous area classification.	Temporary equipment on the existing facility will be subject to existing KPC controls and procedures.
Develop tie-in schedule and plan that maximises plant availability and makes use of opportunistic shutdowns.	See actions 009 and 010 of current HAZID

All outstanding pre-FEED actions (Ref. 5) will also be tracked in SAMS.

4 REFERENCES

1. J08509A-F-HA-20037, HAZID Terms of Reference
2. CON-PR-420, 'HAZID'
3. CON-GN-423, 'HAZID Hazards and Guidewords'
4. CON-FM-425, 'HAZID worksheet template'
5. CON-PR-460, 'SAMS (Safety Action Management System)'
6. Pre-FEED HAZID Study Report J7729A-F-RP-20004 Rev C1

APPENDIX A – HAZID GUIDEWORDS

The listing below is based upon the HAZID Procedure (Ref. 1). Not all guidewords will necessarily be relevant to each node. The list can be adjusted with the approval of the HAZID team, by general consensus.

Hazard Event	Guidewords
Release	Gas
	Liquid
	Condensate
	Prevailing wind
	Venting
	Fugitive
	Gas Ingress
	Bottled Gases Under Pressure
	Other
Fire	Hydrocarbon
	Cellulosic
	Electrical
	Ignition Sources
	Relief / Flare
	Smoke Ingress
	Other
Explosion	Confinement / Congestion
	Air Ingress
	Explosives
	Other
Impact	Rotating Machinery
	Dropped Objects
	Laydown Areas
	Lifting
	Vehicle Movement
	Maintenance
	Mechanical failure
	Other
Structural failure	Primary structures

HAZID Study Report

Qasr Compression Project FEED



Hazard Event	Guidewords
	Temporary structures
Chemicals	Types
	Handling
	Storage
	Protection
	Other
Transport	Road – Personnel
	Road – Goods
	Other
Material problems	Corrosive
	Other
Climatic	Earthquake
	Lightning
	Extreme Weather
	Sandstorms
	Other
Occupational	Hot / Cold Surfaces
	Hot Fluids
	Confined Entry / Asphyxiation
	Working At Height
	Electricity
	Health
	Noise
	Other
Safety Systems Failure	Escape Routes
	EER Equipment
	Primary Muster Area
	Evacuation Means
	Emergency Lighting
	Emergency Power / UPS
	ESD / Blowdown
	PFP
	Firewater
	HVAC

HAZID Study Report

Qasr Compression Project FEED



Hazard Event	Guidewords
	Equipment of Misuse / Human Error
	Other
Construction / hook-up/commissioning	Release
	Fire / Explosion
	Impact
	Transportation
	Structures
	Safety System Failure
	Occupational
	Other
Deliberate Acts	Sabotage
	Terrorism
	Military Action
Other	Radioactive Sources
	Pyrophoric Materials
	Cryogenic Fluids

APPENDIX B – LIST OF ASSUMPTIONS AND ASSURANCES

Ref	Description	Verification by
	No assumptions were made during the HAZID	

HAZID Study Report
Qasr Compression Project FEED



APPENDIX C – HAZID WORKSHEETS

GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Release - Gas	Increased number of potential leak paths.	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel. There have been problems on existing piperacks with excessive overhang weights on some pipe runs.	Design parameters. Materials of construction. Inspection and testing through plant life. Fire and gas detection system. ESD system isolates and blowdown equipment.	Action 001: ensure that piping design reflects lessons learnt from overhang weights on existing plant.	GOGC
Release - Gas	Internal corrosion.	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel. There have been problems on the existing plant arising from poor fabrication of lined vessels.	Materials of construction. Good fabrication and inspection procedure.	Action 002: Ensure that the EPC scope of work specifies requirement for quality control inspections during fabrication with reference to corrosion problems experienced on existing facilities.	GOGC
Release - Gas				Action 003: Ensure that EPC contractor quality control inspectors are aware of corrosion problems experienced on existing facilities.	KPC

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Release - Gas	Galvanic cell corrosion between dissimilar metals.	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel. Some insulating joints have been omitted on existing plant.	Insulating joints between dissimilar metals.	Action 004: Ensure that the EPC scope of work highlights the requirement for insulating joints where required.	GOGC
Release - Gas				Action 005: Ensure that EPC contractor confirms that insulating joints are fitted where required.	KPC
Release - Gas	External corrosion	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel.	Painting and external coating. Cathodic protection installed where required.		
Release - Gas	Pinhole leaks in valve bodies (which have occurred on existing plant).	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel.	Material selection and inspection procedures during fabrication.	Action 006: Ensure that the EPC scope of work specifies requirement for quality control inspections during fabrication with reference to valve body leaks experienced on existing facilities.	GOGC

HAZID Study Report

Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
				Action 007: Ensure that EPC contractor quality control inspectors are aware of valve body leaks experienced on existing facilities.	KPC
Release - Gas	Inadequate support of small bore piping (4" and less) (there have been problems with supports on site-run small bore piping on existing plant)	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel.	Design of piping supports for small bore piping prior to construction.	Action 008: Ensure the scope of work for the EPC contractor requires design of the supports for all piping including 4" and below and that the supports are shown on the isometrics.	GOGC
Release - Gas	Impact of road traffic on the pipe rack over the existing site road.	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel.	Elevation of the pipe rack. Warning signs and crash barriers. Control of authorised vehicle movements around site inside the security fence.		
Release - Gas	Impact of construction activities on existing running plant.	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel.	Construction is largely outside the existing fence. Construction inside the fence is covered by the KPC permit to work procedure.		

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Release - Gas	Tie-ins to existing plant.	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel.	Tie-ins will be controlled by the existing KPC permit to work procedure.	Action 009: provide a schedule of tie-ins and incorporate into the EPC contractor scope of work.	GOGC
Release - Gas				Action 010: Ensure that the EPC contractor prepares a detailed design and execution plan for each tie-in.	KPC
Release - Gas	Vibration around rotating equipment causes instrument connections to fail.	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel.	Design and support of small bore connections.	Action 011: Specify a minimum size of 2" for small bore connections to process and utility lines.	GOGC
Release - Gas	Leaking seals on compressors.	Release of flammable and toxic gas with potential for fire and explosion and exposure of personnel.	Dry gas seals with seal gas on the inner seal and nitrogen buffer between the seals.		

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Release Condensate	- Leaking seals on condensate or closed drain pumps.	Release of flashing flammable liquid with potential for pool fires, flash fires and explosion.	Double seals with inter-space flushing on condensate pumps. Concrete pad under condensate storage and transfer area is surrounded by a kerb and sloped to a sump for recovery of liquid. Fire and gas detection system. ESD system isolates and blows down equipment.		
Release Condensate	- Failure of the body of a condensate or closed drain pump.	Major release of flashing flammable liquid with potential for pool fires, flash fires and explosion.	Vibration monitoring and high vibration trip on each condensate pump.		
Release Condensate	- Sampling of condensate.		Condensate will be sampled on the existing facilities. There are no additional sample points on the new facility.		
Release Condensate	- Fire causes damage to support structure for elevated condensate suction drums.	Major release of flashing flammable liquid with potential for pool fires, flash fires and explosion.	Good design of support structures. Application of foam to extinguish pool fires.	Action 012: Consider the need for passive fire protection on the condensate suction drum support structure.	GOGC

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
				Action 013: Consider the need for active fire protection in the condensate storage area (current ongoing study).	GOGC
Prevailing wind	No hazardous scenarios identified.		Plant layout is based on the prevailing wind direction.		
Venting	Continuous vent of nitrogen from compressor seals.	Release of small quantities of nitrogen, possibly contaminated with hydrocarbon.	Vent discharges to a high point to avoid exposure of personnel.		
Venting	Equipment drained for maintenance into the closed drain drum.	Discharge of vapour from the closed drain drum.	Vapour from the closed drain is routed to the existing cold vent.		
Venting	Continuous vent of reject oxygen-rich gas from the inert gas generator.	High oxygen content in discharge plume increases the flammability range of any hydrocarbon, and hence the likelihood of fire.	Vent to a safe location.	Action 014: Check the dispersion of oxygen from the inert gas generator vent to ensure there is no adverse interaction with any hydrocarbon emission.	GOGC
Fugitive	Leaks from valve stems etc.	Minor loss of hydrocarbons to atmosphere	Not considered a hazardous situation.		

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Gas Ingress	Release of gas enters enclosed space	Potential for fire or explosion within the enclosed space.	Compressor house is only roofed and is not enclosed. The LER has HVAC to maintain positive pressure, with flammable gas detection on the air intake that shuts down non-intrinsically safe equipment. .	Action 015: consider the need for flammable gas detection at the air intake into the instrument air building.	GOGC
			Instrument air building is located within a safe area	Action 016: Provide details of the instrument air building at SALAM, and its ventilation system.	KPC
Bottled Gases Under Pressure	FM 200 provided for fire fighting.	Potential injury or fatality to personnel inside the protected space during discharge of FM 200.	Existing procedures for controlled entry into spaces protected with FM 200 flooding system.		
Release - Other	Hot gas exhaust from gas turbines.	Discharge plume from gas turbine exhaust adversely effects equipment or injures personnel.	Dispersion calculations will determine the height of the stack to ensure there are no adverse consequences in work areas.		
Release - Other	Major release of nitrogen from large inert gas receiver.	Risk of asphyxiation.		Action 017: Consider the necessity for 8 hours supply of nitrogen to the compressors.	GOGC

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
				Action 018: Specify a crash barrier to protect the inert gas receiver.	GOGC

HAZID Study Report

Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Fire Hydrocarbon	– Ignited release of gas or condensate.	Damage to assets, loss of revenue and injury or fatality to personnel.	<p>Hazardous area classification minimises electrical sources of ignition.</p> <p>Permit to work system controls hot work.</p> <p>Equipment is electrically bonded and earthed to prevent static discharge.</p> <p>FM 200 system protects battery rooms, switch gear rooms and gas turbine enclosures.</p> <p>VESDA system protects LER.</p> <p>Portable extinguishers are installed at strategic locations.</p> <p>Fire and gas detection system.</p> <p>ESD system isolates and blows down equipment. Isolatable sections minimise trapped inventories.</p> <p>Fire zones have minimum separation distances specified.</p>		
Genesis Oil & Gas Consultants Ltd File name:	J08509A-F-HA-20036 Rev D1 HAZID Study Report		Fire risk assesment will identify all resonably foreseeable fire scenarios and will specify appropriate precautions.	Date: Nov 11 Revision: D1	

HAZID Study Report

Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Fire Hydrocarbon –	Gas leaks inside gas turbine enclosures.	Fire inside the gas turbine enclosure.	Fire and gas detection system. FM 200 is released on confirmed fire.		
Cellulosic - fires	Fire in the office in the LER.	Damage to assets and potential injury to personnel.	VESDA system. FM 200 protection for the equipment room.		
Electrical - Fires	Fire in the switchgear or battery room.	Damage to assets and potential injury to personnel.	Automatic discharge of FM 200 on detection of confirmed fire. Battery rooms are protected with hydrogen detectors.		
Relief and Flare	Major discharge to flare.	Potential to exceed design limit of existing flare systems.	Controlled sequential blowdown of equipment to prevent overload of the flare.		
Smoke Ingress	Smoke from external fire drawn into enclosed building.	Damage to assets and potential injury to personnel.	Smoke detection on the HVAC air intakes for all occupied buildings.		
Other	No other fire hazards identified				

HAZID Study Report

Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Explosion – Confinement and congestion	Ignition of an accumulation of flammable gas close to stoichiometry in an enclosed or confined space.	Explosion	The compressor house is an open sided well ventilated structure. LER, Battery and Switchgear rooms are all protected by HVAC with gas detection on the air intake which closes fire dampers to protect the building.		
Explosion – Confinement and congestion	Accumulation of heavy HC vapour in the below grade pit which contains the closed drain drum.	Explosion	Gas detection in the pit, which is uncovered to provide explosion vent area.	Action 019: Consider redesigning the closed drain drum so that all connections are top entry from above grade and the pit can be filled with inert material such as sand.	GOGC
Air ingress into hydrocarbon containing equipment.	In-breathing from the cold vent into the closed drain drum.	Internal explosion in the closed drains drum.	Cold vent system is purged with fuel gas.		
Air ingress into hydrocarbon containing equipment.	Nitrogen from the inert gas generator contains significant oxygen.	Contamination of HC, and possible internal explosion in equipment.	Oxygen analyser on the inert gas generator which alarms on high oxygen content and trips the inert gas generator on HH oxygen.		
Explosives	None identified				

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Other	No other explosion hazards identified				
Impact - Rotating Machinery	Compressor or turbine throwing a blade.	Potential for mechanical damage or injury to personnel.	Compressor casing and turbine enclosure are designed to contain thrown blades.	Action 020: Ensure that the specification for the gas turbine and compressor packages includes a requirement for thrown blade protection.	GOGC
Impact - Rotating Machinery	Condensate and closed drain pumps - see loss of containment.				
Impact - Dropped Objects	Crane or lifting gear operation	Potential for damage to assets or injury to personnel.	Existing procedures for safe operation of lifting equipment.		
Impact - Dropped Objects	Overhaul of compressors and gas turbines.	Need to change out large items of equipment in the compressor house.		Action 021: Confirm that there are adequate arrangements to allow safe movement of compressor and turbine components within the compressor house, and onto a low loader on the access road.	GOGC

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Impact - Dropped Objects	Access for maintenance of the existing power generators after the new generator has been installed.	Potentially restricted access between the new and existing generators.		Action 022: Ensure there is adequate separation between the new power unit and the existing power generators to allow good access to both.	GOGC
Impact - Lifting	Change out of fan motors on coolers.	Difficult access to fan motors.		Action 023: Provide a mobile self elevating work platform suitable for the change out of fans and motors on air coolers.	KPC
Impact - Vehicle Movements	No new causes				
Impact Maintenance -	No new causes				
Impact Mechanical Failure -	No new causes				
Structural Failure	No new causes				
Chemicals	No new hazards. Existing chemical systems will be extended to supply the new facilities.				
Transport	No new hazards				

HAZID Study Report

Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Material Problems corrosion -	Mercury in the gas.	Potential damage to aluminium components in the gas turbine.	Mercury removal bed in the fuel gas system.		
Material Problems corrosion -	High CO ₂ content in the gas (10%)	Potential for corrosion in piping and in equipment.	Material selection and fabrication.		
Material Problems corrosion -	High salt content of produced water	Potential for stress corrosion cracking in piping and equipment	Material selection, and control of fabrication.		
Material Problems corrosion -	H ₂ S in gas (10 ppm)	Potential for hydrogen induced cracking.	Material selection, and control of fabrication		
Climate Earthquake -	Zone 2 seismic region	Potential for structural damage to assets.	Civil design includes appropriate seismic safety factors.		
Climate Lightning -	Lightning strikes	Potential damage to electrical equipment, and potential to ignite the cold vent.	Lightning protection currently located on the Switchgear and Control Rooms.	Action 024: Consider the need for, and extent of, lightning protection.	GOGC
Climate Sandstorms -	Sandstorms are frequent in the area particularly in April and May.	Potential for blockage on the air intakes on the gas turbines and instrument air systems.	Self cleaning filters on the gas turbine air intakes. Manual cleaning of the instrument air intakes.		

HAZID Study Report

Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Climate Extreme Weather, Fog	- Atmospheric condensation on the gas turbine intake filters.	Damage to paper filters on the air intakes.	Stainless steel filters are used which are not affected by condensation.		
Occupational Hot Surfaces	- High temperature of the gas turbine exhausts and the compressor discharges.	Potential injuries to personnel who come in contact to the hot surfaces.	Personnel protection on all hot surfaces.		
Occupational Confined entry and asphyxiation	- Large inventory of nitrogen in the inert gas receiver.	Potential for asphyxiation if personnel are exposed to nitrogen leaks.	Inert gas receiver is located in a well-ventilated area and is protected from impact with crash barriers.		
Occupational Confined entry and asphyxiation	- Vessel entry for inspection.	Work in confined spaces.	Permit to work and vessel entry procedures.		
Occupational -	Change out of adsorbent in mercury bed.	Exposure of personnel to mercury contaminated pyrophoric material.	Permit to work procedure, PPE, nitrogen blanketing. Use of a specialist contractor for change out and disposal.	Action 025: Ensure that the mercury bed specification includes a requirement for access to facilitate charging and discharging adsorbent e.g. flanged heads on the vessels.	GOGC
Occupational Working height.	- Access to condensate suction drums (8m elevation)	Injury to personnel unless there is good access.		Action 026: Ensure there are working platforms with adequate access around the condensate suction drums.	GOGC

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Occupational -	Maintenance of PSVs and BDVs	Injury to personnel unless there is good access.		Action 027: Ensure there are working platforms with adequate access to allow safe access to PSVs and BDVs	GOGC
Occupational Electricity	- Live electrical equipment	Potential fatalities of personnel in contact with live electrical equipment.	Lock-out/Tag-out procedure and controlled access to switch rooms.	Action 028: Define the safeguards to prevent unauthorised access to switch rooms, and other live electrical equipment.	KPC
Occupational Health	- Exposure to hazardous materials e.g. BTEX in condensate, or methanol.	Adverse effects on operators' health.	Periodical environmental monitoring and PPE.		
Occupational Noise	- Noisy equipment e.g. gas turbines, compressors and pressure let down valves.	Adverse effects on operators' health.	Specification of maximum noise levels for new equipment. Acoustic enclosure around gas turbines. Noise study to identify areas where hearing protection may be required. PPE.		
Occupational Other	- No new hazards identified.				

HAZID Study Report
Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Safety Systems failure – Escape Routes	Escape route blocked.	Ability to escape in an emergency is jeopardised.	At least two escape routes from each working area.		
Safety Systems failure – Emergency lighting			Emergency lighting in all buildings (LER and instrument air building)		
Safety Systems failure – Emergency Power and UPS			New emergency generator and UPS installed. Facility to keep the turbine and compressors turning during the cool-down period to prevent bowing of the shafts.		
Safety Systems failure – ESD and Blowdown			Existing ESD and Blowdown philosophy is applied to the new facilities.		
Safety Systems failure – PFP	No new hazards – see fire.		Fire risk assessment will identify any areas where PFP is required.		
Safety Systems failure – Firewater	There is no firewater system.				

HAZID Study Report

Qasr Compression Project FEED



GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Safety Systems failure – HVAC	Loss of power	Ventilated enclosures are inadequately protected unless dampers close.		Action 029: Ensure the specification for HVAC equipment requires dampers to close on loss of power.	GOGC
Construction Release -	Emergency on a running plant.	Requirement to evacuate all construction personnel.		Action 030: Develop a procedure for good communication between operations and construction, both during normal operation and in an emergency.	KPC
Construction Release -				Action 031: EPC ITT package to include requirement for construction contractor's personnel to be inducted at site on KPC's safety requirements, which are mandatory.	GOGC
Construction Transportation -	Transportation of heavy equipment into the construction site.	Requirement for transport to cross existing pipe route.		Action 032: EPC ITT package to include requirement for contractor to develop and implement design for temporary access road including pipeline crossing.	GOGC

HAZID Study Report
Qasr Compression Project FEED

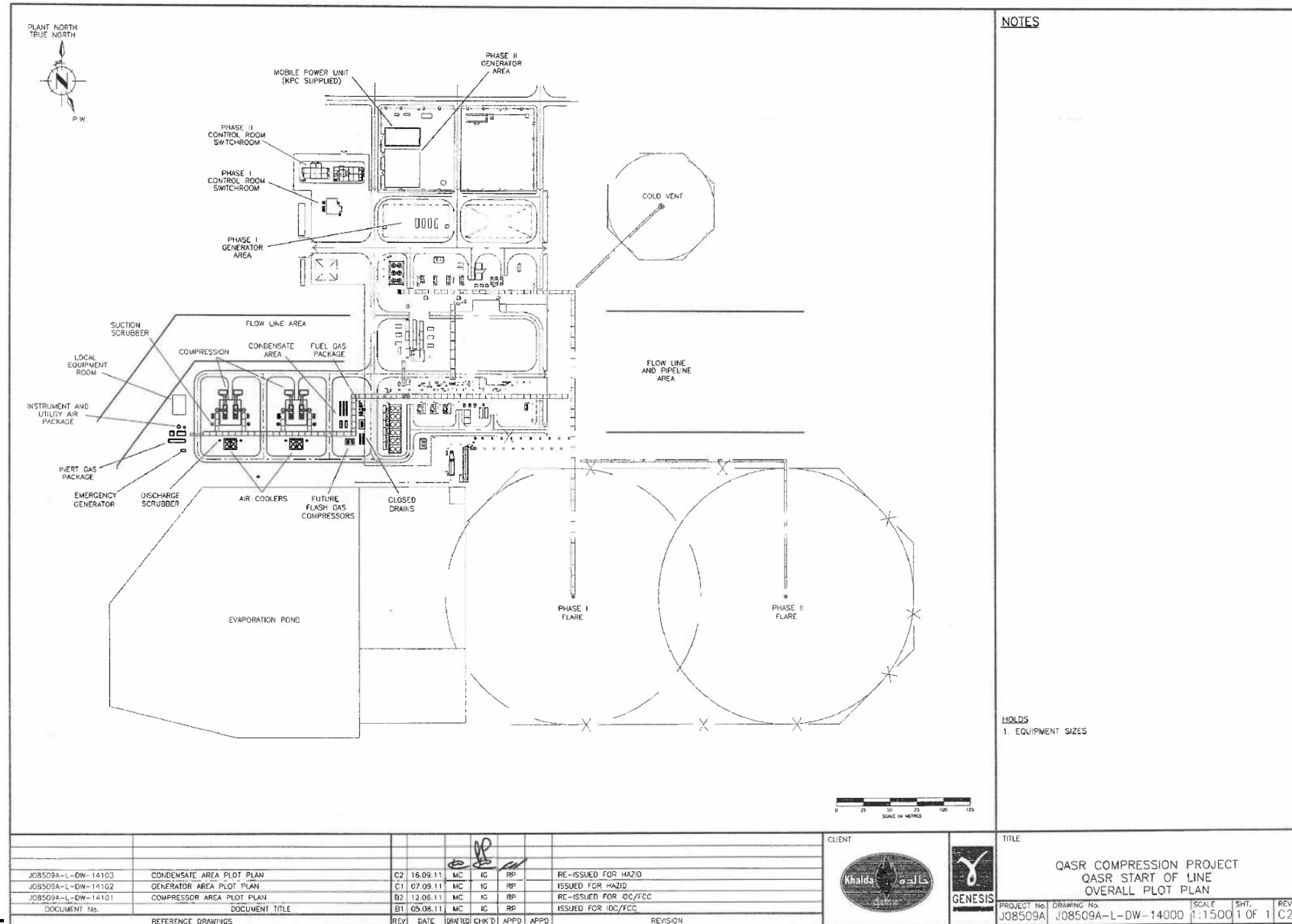


GUIDEWORD	CAUSE	CONSEQUENCE	SAFEGUARDS	ACTION	BY
Construction - Transportation	Construction activities adjacent to the evaporation pond	Potential for contractors to damage evaporation pond.	Fence between the construction area and the evaporation pond, which includes a safety distance.		
Deliberate Acts	Sabotage	Damage to assets and loss of production.	Existing security systems will protect the new facilities.		
Other	No other hazards identified.				

APPENDIX D - HAZID DOCUMENTATION

HAZID Study Report

Qasr Compression Project FEED



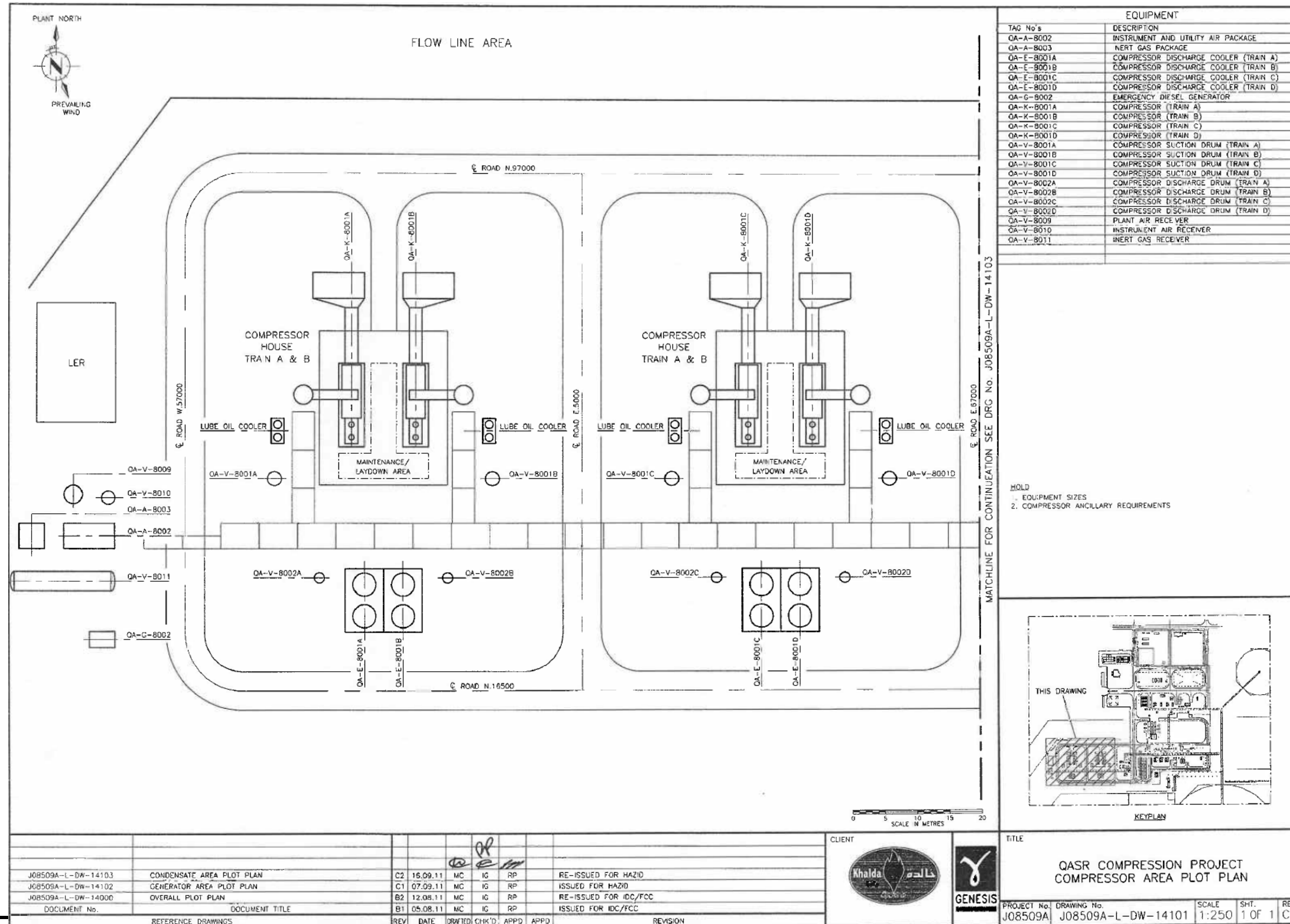
Genesis Oil & Gas J:\GWS\DATA\DATA\J08509A\14 PIPING & LAYOUT\PILOT PLANS\REV C2\J08509A-L-DW-14000 REV C2 - OVERALL PLOT PLAN.DWG

File name: J08509A-F-HA-20036 Rev D1 HAZID Study Report

Revision: D1

HAZID Study Report

Qasr Compression Project FEED

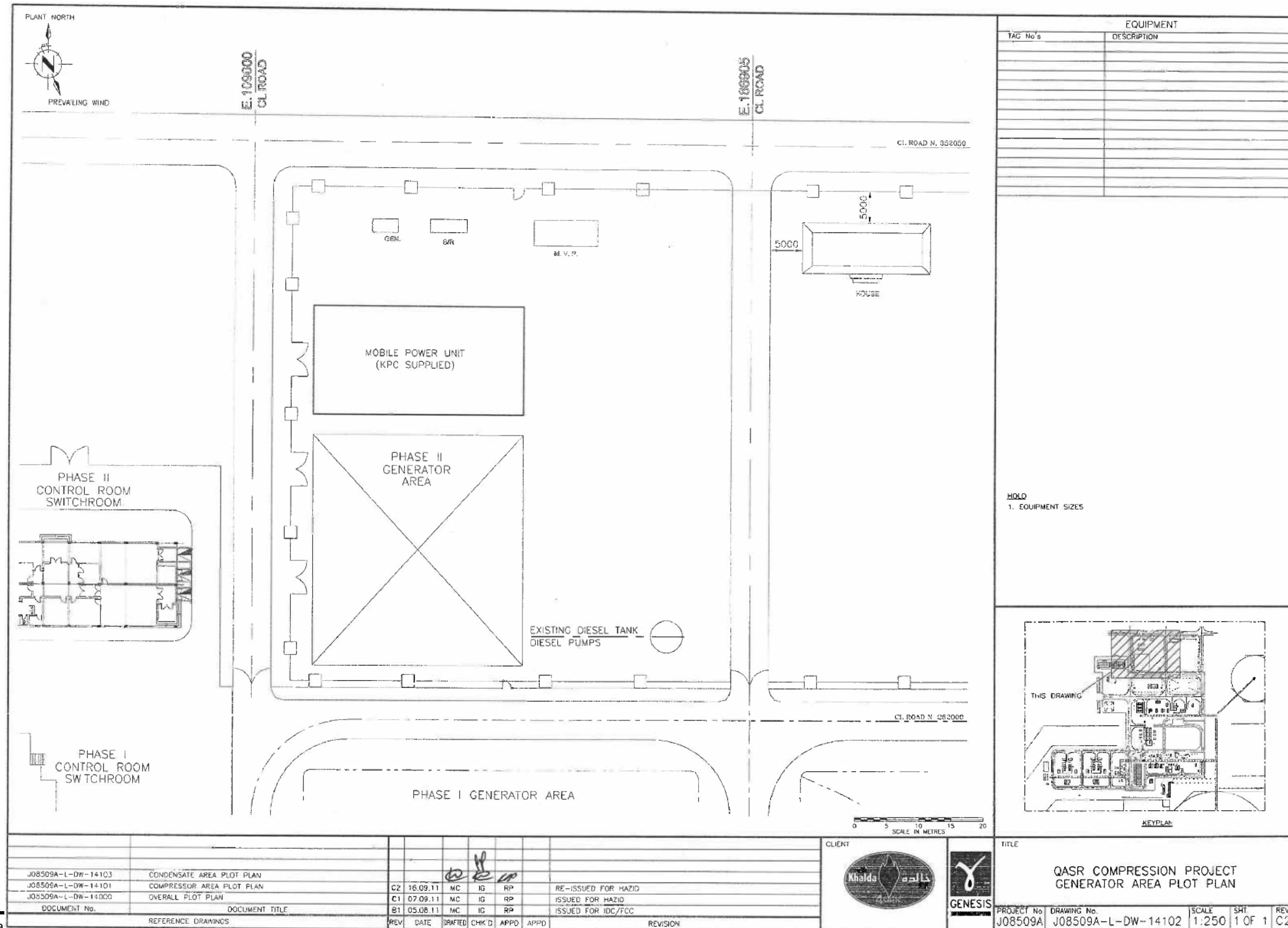


Genesis Oil & Gas

File name: J08509A-F-HA-20036 Rev D1 HAZID Study Report

Revision: D1

HAZID Study Report Qasr Compression Project FEED



Genesis Oil & Gas

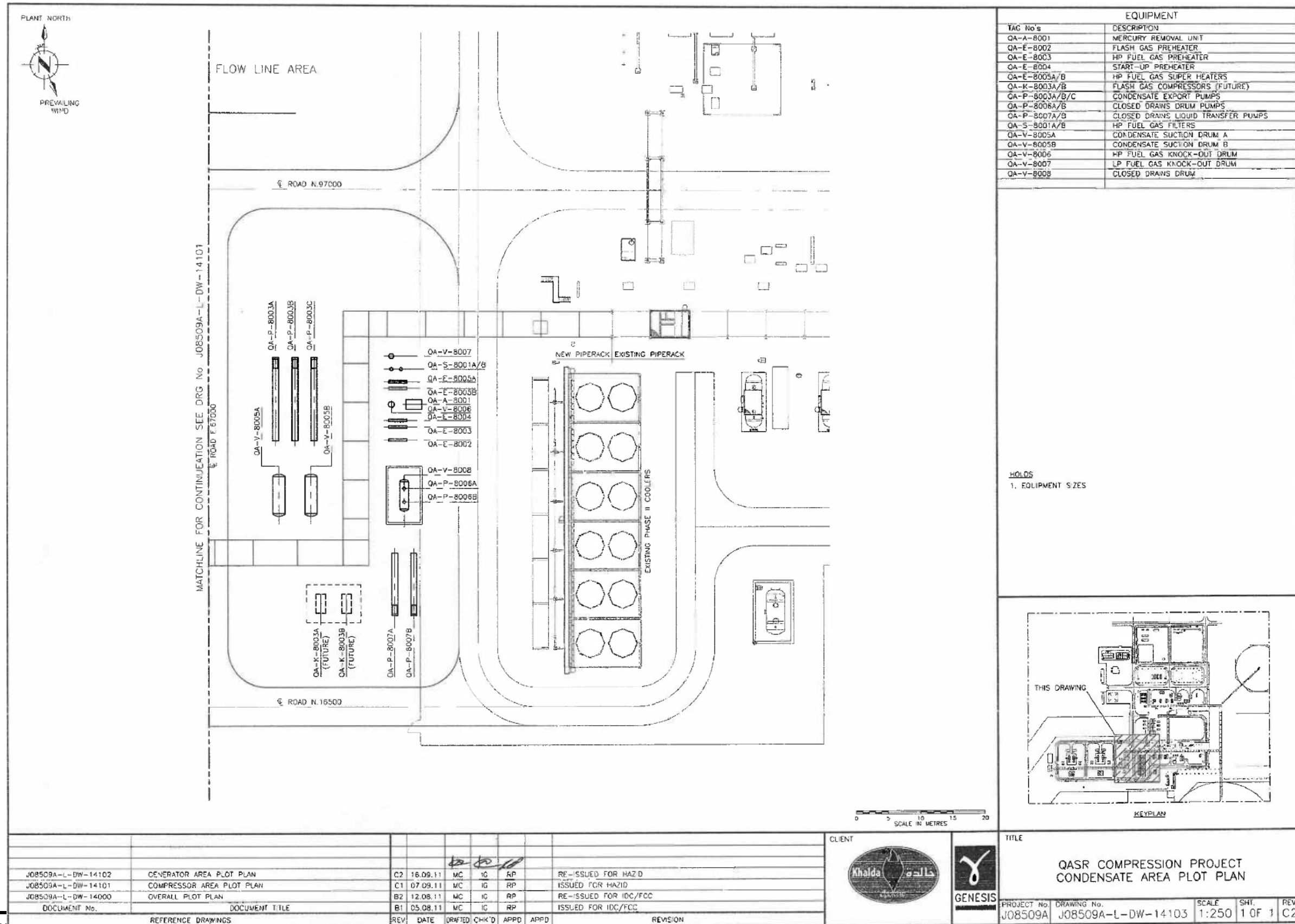
File name:

J08509A-F-HA-20036 Rev D1 HAZID Study Report

Revision: D1

HAZID Study Report

Qasr Compression Project FEED



Genesis Oil & Gas

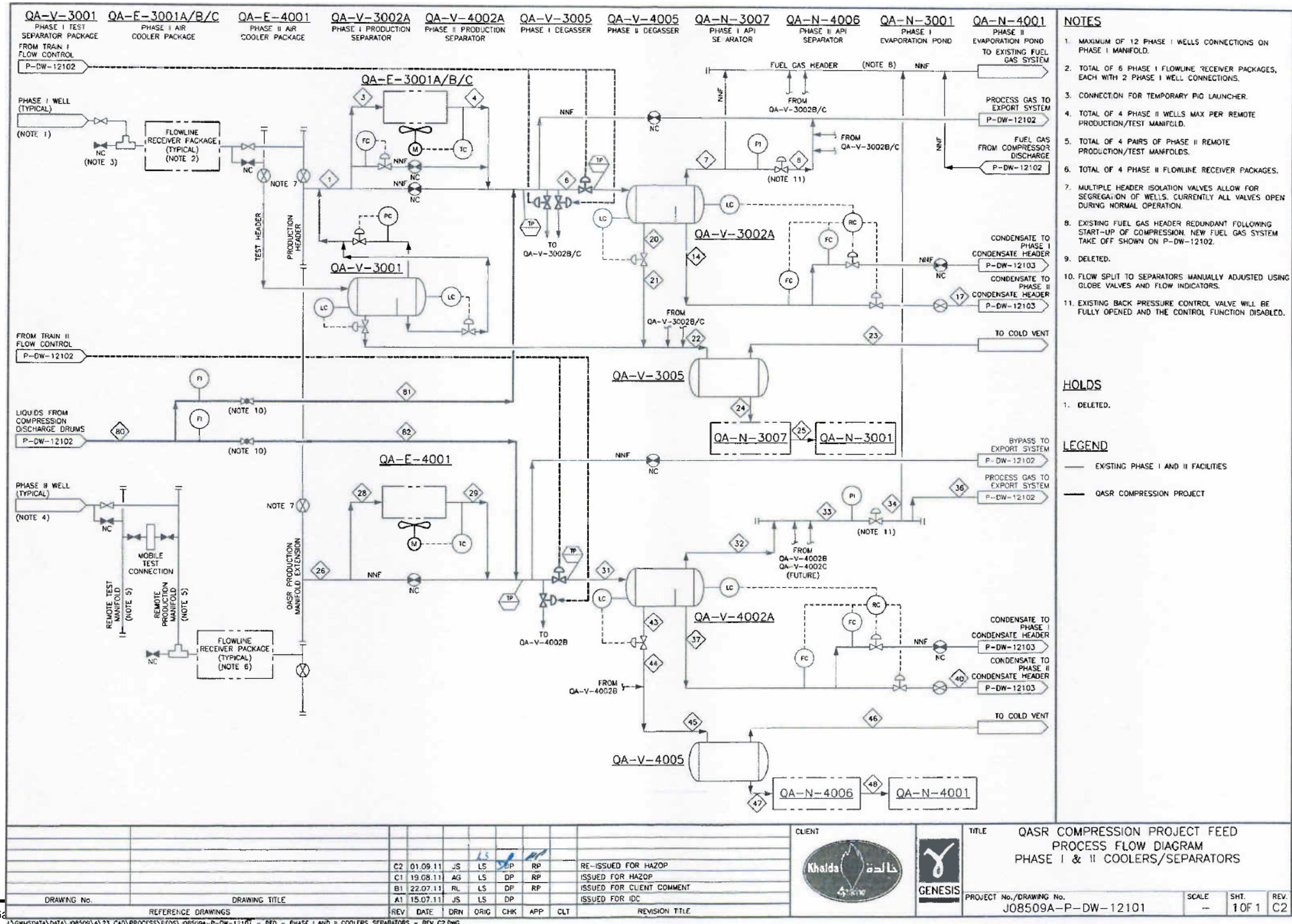
File name:

J08509A-F-HA-20036 Rev D1 HAZID Study Report

Revision: D1

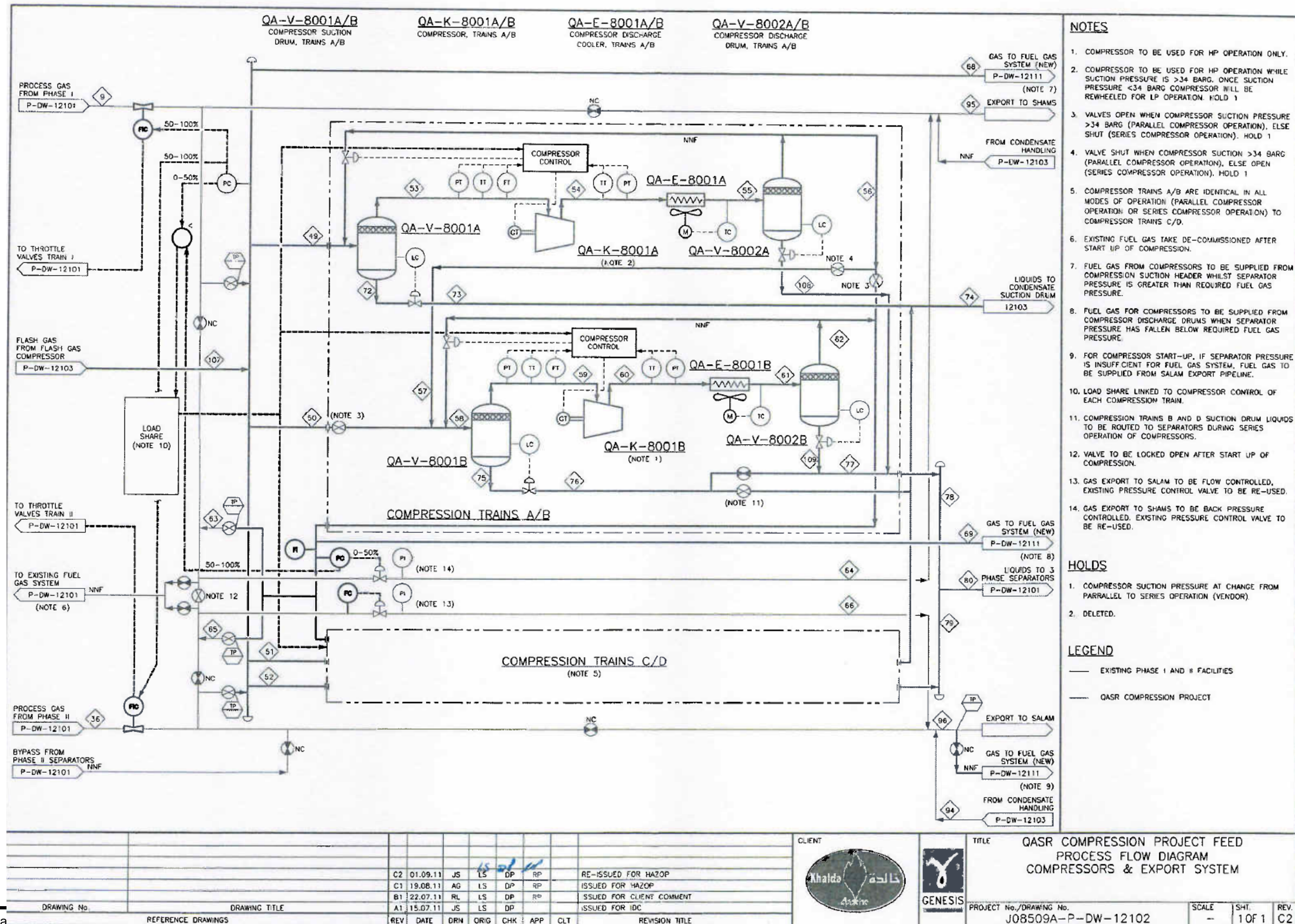
HAZID Study Report

Qasr Compression Project FEED



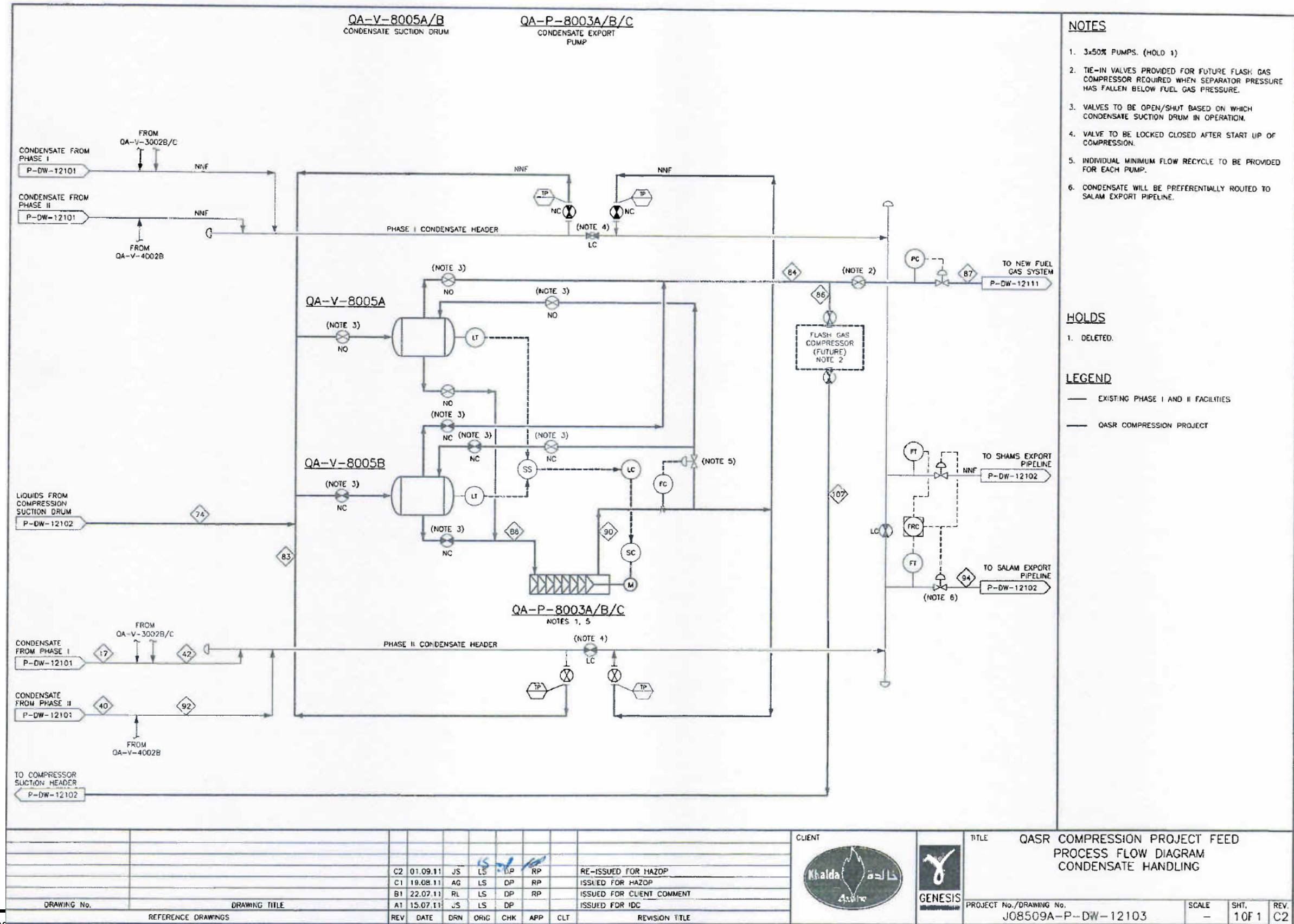
HAZID Study Report

Qasr Compression Project FEED



HAZID Study Report

Qasr Compression Project FEED



HAZID Study Report

Qasr Compression Project FEED

